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## COMPOSITE BOARD

## BACKGROUND OF THE INVENTION

5 [0001] This invention relates to a composite board and a method of making the board.

[0002] Composite boards have numerous applications in industry and allow for the variation of the characteristics of any component such as a panel made there from.

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## SUMMARY OF THE INVENTION

[0003] This invention aims to provide an alternative composite board and a method of manufacture thereof.

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[0004] The invention provides a composite board which includes a moulded front wall, a sheet insert which is attached to the front wall, a frame element which is attached to the front wall and the insert and an adhesive which acts between the front wall, the insert and the frame element.

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[0005] The front wall may be made from a mouldable composition which may include a first resin and a catalyst. The first resin may be a thermosetting resin and the mouldable composition may include a filler and an additive selected from any one or combination of an anti-foaming agent, a surfactant, an accelerator and pigment.

25 [0006] Alternatively the mouldable composition may include a hydraulic binder and reinforcing.

[0007] The insert may be made from an expanded or foamed material which may include any one of polystyrene, polyurethane and phenolic foams.

[0008] In an alternative form of the invention the insert is made from an open-celled polymeric foam which may be impregnated with a hydraulic binder.

[0009] The frame element may be made from any appropriate material such as wood.

5 [0010] The adhesive may include a second resin and a catalyst. The second resin may be a thermosetting resin.

[0011] The adhesive may include a filler and an anti-foaming agent.

[0012] The board may include a reinforcing member which is submerged in the adhesive.

10 [0013] The insert may be covered with a sealant which may be in the form of a thermoplastics polymer.

[0014] The board may include a backing sheet which covers the insert and the frame element or the board may include a connecting layer which is applied to the insert and the frame element with which a second composite board is secured to the insert  
15 and the frame element.

[0015] The invention also provides a method of manufacturing a composite board of the aforementioned kind which includes the steps of:

A) applying a mouldable composition to a mould surface;

B) allowing the mouldable composition to set to form a front wall;

20 C) applying an adhesive to the front wall;

D) engaging a sheet insert and a frame element with the adhesive; and

E) allowing the front wall, insert and frame element to be attached to one another by the adhesive.

[0016] The mould surface may be made from silicone rubber.

5 [0017] The method may include the steps of submerging a reinforcing member in the adhesive, covering the sheet with a sealant and attaching a backing sheet over the insert and the frame element.

[0018] Alternatively the method may include the steps of applying a connecting layer to the insert and the frame element and securing a second composite board to the  
10 insert and the frame element by way of the connecting layer.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The invention is further described by way of examples with reference to the accompanying drawings in which:

Figures 1A to 1E are partial, cross sectional and schematic representations of is a  
15 method according to the invention to manufacture a composite board of the invention; and

Figures 2 to 4 are partial, cross sectional and schematic representations of a composite board manufactured according to the method of Figures 1 and a composite panel made there from.

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## DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] Figures 1A to 1E show how a composite board 10 which is shown in Figure 1E is manufactured. The board 10 has an outer front wall 12 which has an inner side 14 and an opposite outer side 16, an adhesive 18 applied to the inner side 14, a  
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reinforcing layer 20 embedded in the adhesive 18, a sheet insert 22 which is attached to the wall 12 by the adhesive 18, a rigid frame member 24 which is attached to the wall 12 and the insert 22 by the adhesive 18 and a backing sheet 26 which is fixed to the insert 22 and frame 24 on an opposite side to the wall 12.

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[0021] The board 10 can be used in any appropriate application such as for example a cabinet door.

[0022] Figure 1A shows a front mould 30 use in the manufacture of the board 10.

10 The mould 30 is made from a silicone rubber. The mould 30 has the profile and surface detail which is desired to be imparted to the board 10.

[0023] In a first step shown in Figure 1B a layer of a mouldable composition 32 is applied to a face 34 of the mould 30. The composition 32 is applied to the mould by  
15 brush, by spray, by curtain coater or by any other suitable means to provide a layer that is uniform in thickness. The thickness of the layer is preferably from 100 microns to 1 mm inclusive.

[0024] In a first example of the invention the composition 32 comprises a first  
20 thermosetting resin and a catalyst for the resin. The resin is preferably a liquid polyester resin such as the unsaturated isophthalic or orthophthalic liquid polyester resins. Examples of these are those manufactured by Scott Bader of England including Crystic™ 272 catalysed by catalyst powder B and Crystic™ 196 and those under the Atlac™ brand by DSM.

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[0025] Other suitable polyester resins are those produced by National Chemical Products, Germiston, South Africa, such as PolyLite™ 33410, PolyLite™ 8130, PolyLite™ 8000 and PolyLite™ 8382X. Suitable latent catalysts for these resins include di-tert-butyl peroxy 3,3,5-trimethylcyclohexane in dibutyl phthalate such as those sold by Akzo  
30 Chemie under the name Triganox™ 29B240, Lucidol™ KL50, Triganox™ 21, Triganox™ C or Triganox™ K-70, benzoyl peroxide formulations, t-butylperbenzoate sold by Interlox under codes TBTB and TBPB, dibenzoyl peroxide sold by Interlox under

code MIKP NAI or t-Butyl 2-perethyl hexanoate. These catalysts generally trigger polymerisation at a temperature in the region of 60°C upwards, more typically 80°C upwards.

- 5 [0026] Suitable room temperature catalysts for these resins which have been accelerated with accelerators such as cobalt octoates or naphthenates or tertiary amines, are organic peroxides such as methylethyl ketone peroxide, cyclohexanone peroxide and similar.
- 10 [0027] The composition 32 includes 50 to 350% by weight and preferably about 300% by weight of the resin of an inorganic particulate filler. The filler is included for sizing, as a heat sink, for cohesive strength and for liquid phase flow. The preferred filler is barium sulphate at a specific gravity of approximately 4,8 and a particle size of approximately 300 mesh. Barium sulphate is particularly used to promote flow, to settle  
15 into the mould surface picking up every detail, to add cohesive strength to the composition and to minimise shrinkage. Calcium carbonate (10 micron particle size) is added in certain applications to balance the barium sulphate.
- [0028] Other possible fillers include calcium carbonate, talc, hollow glass balloons,  
20 kaolin, silica or mica, all in the particle size spectrum range of from 65 to 300 mesh.
- [0029] Depending on requirements the composition 32 includes additives such as an anti-foam agent, for example Byk 057 or Byk 066 for unsaturated polyesters, or Byk 085 for phenol formaldehyde resole resins, a surfactant such as Disperbyk 163 or  
25 Tween 20 which is a polyoxethylene 20 sorbitan monolaurate by ICI, for either polyester or phenolic resins and appropriate pigment such as titanium dioxide and yellow oxide.
- [0030] These agents are added to ensure that the composition flows easily across the mould surface, wetting it intimately, that all entrained bubbles are freely and easily  
30 released so that the front layer is seamless, without bubbles and of consistent thickness without pull away, fish eyes or similar defects and to obtain appropriate colouring of the wall 12.

**[0031]** An example of the ingredients of the first composition 32 which is for a board 10 to simulating wood, is as follows:

3kg PolyLite 33410 (Isophthalic unsaturated polyester resin by NCP - RSA) is used as a resin, 24g ACl accelerator (NCS Resins, RSA) (a 1 % solution of cobalt naphthanate in white spirits) is used as an accelerator, 15g Tween 20 (ICI) is used as a surfactant, 8g Byk 057 (Byk Chemie) is used as an anti-foam agent, 30g methylethyl ketone peroxide is used as a catalyst, 2.4g Barium Sulphate is used as a filler and is balanced by 600g calcium carbonate (10 micron particle size), and 140g titanium dioxide and 18g yellow oxide which are used as pigment.

**[0032]** The composition 32 is allowed to polymerise to form the wall 12. For example, the mould 30 is passed under an inductive heat source such as infra red lamps in order to polymerise the thermosetting resin before the next part of the composite board 10 is added.

**[0033]** Alternatively to the first composition 32 a second composition 32 can be used which has a hydraulic binder slurry reinforced with a choice of either a thermoplastic polymer or a water dispersible, miscible or soluble thermosetting resin which is allowed to polymerise or to set to form the wall 12.

**[0034]** The binder slurry is reinforced with a thermoplastic polymer in water chosen from an acrylate, a methacrylate, a vinyl, a polyvinyl alcohol or a polyvinyl acetate for the purpose of easily wetting of the reinforcing layer 20 and to promote the adhesion and cohesion of the binder slurry to the reinforcing layer 20. Alternatively water soluble, miscible or dispersible thermosets chosen from oligo isocyanates, unsaturated polyesters or phenol formaldehyde resoles can reinforce the binder slurry, either on their own or in combination with the thermoplastic polymers above with which, in the case of the oligo isocyanites in particular, a cross link can occur.

[0035] When a binder slurry is used in the second composition 32 and a polystyrene core is used as the insert 22 the core does not require to be sealed against solvent attack.

5 [0036] In Figure 1C the adhesive 18 is applied to the front wall 12 after the composition 32 had set or polymerised. The adhesive 18 comprises a second thermosetting resin and catalyst extended with lightweight hollow glass balloons. The second resin is preferably an unsaturated polyester resin and the catalyst is any appropriate one. The adhesive 18 also has a lightweight filler such as Cenolite or Fillite  
10 with 60% fill resin by mass i.e. 1000g of resin to 600g of the hollow glass balloons which have a bulk density in the range 200 to 300g/l and an anti-foam agent such as DB100 by Dow Corning.

[0037] The second thermosetting resin can be the same as the first thermosetting  
15 resin of the wall 12 to promote cross-linking.

[0038] The adhesive 18 is used to adhere the wall 12 to the reinforcing layer 20, the insert 22 and the frame 24.

20 [0039] Figure 1D shows the placement of the reinforcing layer 20 which is in the form of woven fibre glass roving in the weight range 150 to 350g/m<sup>2</sup> with flat weave which is easily wetted by the adhesive 18. The reinforcing layer 20 can also be a non woven synthetic polymer fibre in the range 120 to 450g/m<sup>3</sup> such as 130g/m<sup>2</sup> bi-component non woven, 85% polyester fibre and 15% polypropylene fibre.

25 [0040] A further quantity of the adhesive 18 is applied over the reinforcing layer 20 so that the reinforcing layer 20 is submerged in the adhesive 18.

[0041] The insert 22 and the frame 24 are located on the reinforcing layer 20 and  
30 the adhesive 18, as is shown in Figure 1E, wells up between the insert 22 and the frame 24. Once set the adhesive 18 attaches the reinforcing layer 20, the insert 22, the frame 24 and the wall 12 to one another.

[0042] The insert 22 is a shaped expanded polystyrene foam core 36 sealed with an acrylic resin sealant 38.

5 [0043] The core 36 is of a density between 24 and 40kg/m<sup>3</sup> and is either formed by injection moulding or by post cutting with a hot wire to exactly the edge profile required to minimise consumption of the adhesive 18 and to ensure that a rear surface 40 presented to the back has no indentations, voids or gaps after sanding.

10 [0044] The sealant 38 is preferably a thermoplastic polymer in water chosen from acrylates, methacrylates, vinyls, or polyvinyl alcohols or any combinations or co-polymers between them or a phenol formaldehyde resole resin with a catalyst therefore. Suitable examples are E330 Acrylic Polymer by Rohm & Haas or Polyvinyl Alcohol 5 to 10% solution in water or Mowiol™ 18/88 by Clariant or resin code 1028 with catalyst  
15 Phencat™ 10 by Schenectady Corporation to coat the core 36. The sealant 38 can be applied by brush or by spray and preferably does not contain any filler or extender.

[0045] Alternatively the solvent resistant sealant 38 is a solution of Gelatin in water applied at a temperature exceeding 30°C and more preferably 45°C. The sealant 38  
20 can contain Glycerol at a proportion of up to 60% of the dry mass of Gelatin, and preferably in the range of 35% to 50% in order to impose toughness to the sealant film after drying.

[0046] The surface of the core 36 is dried and the acrylic coalesces forms an  
25 unbroken film which is resistant to the attack of solvents such as the styrene monomer in unsaturated polyester resins which would penetrate the core 36 without the unbroken acrylic film and dissolve the polystyrene of the core 26, making it unsuitable for the application.

30 [0047] The core 36, first sealed by the sealant 36 in water or alcohol medium can after drying, be further over sealed by a further sealant in the solvent medium which is allowed to set or to dry before the sealed core 36 is placed into the adhesive 18 before



it has set and there by ensuring an unbroken inter layer of the adhesive 18 between the wall 12 and the insert 22 and without entrapped bubbles of air.

[0048] The insert 22 connects the wall 12 to the backing sheet 26. The insert 22 gives excellent thermal insulation, minimizes weight and is cost effective and tough. Less preferred alternates to polystyrene foam are rigid polyurethane or phenolic foams.

[0049] When resistance to fire is important for the board 10 the insert 22 is made of a flexible open cell polymeric foam such as a polyurethane foam which has been impregnated with an hydraulic binder slurry chosen from gypsum, which is the alpha or the beta hemihydrate of calcium sulphate, or alternatively a Portland cement or a blend between the two. The gypsum or Portland cement is allowed to set and dry to form a rigid core 36 resistant to fire in the dry density range 200 to 500kg/m<sup>3</sup>. The open cell polyurethane foam is in the density range 6 to 12kg/m<sup>3</sup> and with a cell size in the range 0.5 to 6mm in diameter. The foam is impregnated and the insert 22 is made in a known manner.

[0050] The frame 24 is in the form of an elongate wooden member which is machined to the profile of the mould 30. The frame 24 can be made from any wood substitutes which can accommodate mechanical fixings such as hinges, handles, bolts and jointly mechanisms such as screws and which can impart strength and stability to the board 10.

[0051] Once the adhesive 18 has set the rear surface 40 is sanded if required and the backing sheet 26 is laminated over the insert 22 and the frame 24 with an appropriate thermosetting resin and catalyst to form the board 10 shown in Figure 1F. In this example the backing sheet 26 is in the form of white melamine. The backing sheet 26 can however be made from any appropriate material such as metal, plastics, rubber, wood or paper.

[0052] Figure 2 shows a board 10B made according to the method described with reference to Figures 1. The board 10B however does not have a backing sheet 26 attached to its rear surface 40.

- 5 [0053] In Figure 3 the board 10B is placed back to back with an identical second board 10C. A connecting layer 50 which is shown in Figure 4 is applied to the respective inserts 22 and frames 24 on the respective rear surfaces 40 of the boards 10B and 10C. The boards 10B and 10C are brought together and glued to form a composite panel 52.

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[0054] The connecting layer 50 is solvent free or is in water or alcohol or alternatively with a hot melt or in the form of a contact adhesive which does not contain solvents.

- 15 [0055] The construction of the panel 52 ensures dimensional stability as each board 10B, 10C form half of the panel 52 and balances the tensions in the other. It also assists in the accurate control of thickness.

- 20 [0056] The advantages of the board 10 or the panel 52 of the invention are that they have high strength to weight ratios, are lightweight, provide surfaces that simulate natural material such as wood, stucco, stone or rendering, have good thermal insulation properties, can be made to conform to any profile, are easy to incorporate into another structure by mechanical methods, are seamless, waterproof, resistance to wear or weather and cost effective.

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